CLIPPEDIMAGE= JP409251538A

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TITLE: DEVICE AND METHOD FOR JUDGING PRESENCE OR ABSENCE OF OBJECT

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ABSTRACT:

PROBLEM TO BE SOLVED: To reduce an erroneous correspondence rate by extracting
correspondent points, for which the phase difference of correspondent points
extracted on mutually different conditions is mutually equal, from the
correspondent points of a stereo image as matched correspondent points and
removing the picture elements of erroneous correspondence out of the
correspondent points.

SOLUTION: A correspondent point search part 14 extracts the picture elements,
which become the correspondent points, from the stereo image on conditions 1 by
comparing them with a feature value. On the conditions 1, the correspondent
points of phase difference are extracted inside the range of an object, and the
correspondent points are extracted in the areas on the right side and downside
of the image. The correspondent point search part 14 extracts the picture
elements to become the correspondent points from the stereo image on conditions
2. On the conditions 2, the correspondent points are extracted in the areas on
the upper left side and the down side in addition to the correspondent points.
Among the correspondent points in the left image extracted on both the
conditions, the correspondent points of the equal phase difference on both the
conditions are extracted as the matched correspondent points by a left matched
correspondent point extraction part 26. Among the correspondent points in the
right image, the correspondent points of equal phase difference on both the
conditions are extracted as the matched correspondent points by a right matched
correspondent point extraction part 28.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the equipment and the method of judging existence of the existence of the body in a stereo picture from the distribution of the phase contrast of the phase contrast picture acquired by the stereo method.
[0002]
[Description of the Prior Art] An example of the equipment which measures the position where a body exists using the conventional stereo method is indicated by reference: "a picture lab, 1994.11, pp.65-67, and Japanese industrial publication." With the equipment of an indication in this reference, the distance from the camera of the body which divides a visual field in the 480 directions and exists in each direction is computed. And in order to reduce the amount sampled spatially in calculation of the distance and to plan a real-time operation, in each of a shade picture on either side, only the one scanning line is chosen every five, and the image data of five directions is extracted for every selected scanning line of this. And the corresponding points of a shade picture on either side are detected using the extracted image data, and an objective distance is computed based on the phase contrast of these corresponding points.
[0003]
[Problem(s) to be Solved by the Invention] However, with the conventional equipment mentioned above, an objective distance is computed only using the one scanning line among five. For this reason, it can only catch using as a rectangle pattern (block pattern) the body which exists all over a screen. Moreover, resolution of a shade picture cannot be made finer than this block pattern, either.
[0004] By the way, generally as an image pickup device of the camera of the right and left for acquiring a stereo picture, CCD (Charge Coupled Device) is used. The picture signal from CCD is digitized for signal processing, and is memorized. For this reason, the memorized picture signal contains the quantization error by digitization.
[0005] Consequently, if an objective distance is computed based on a picture signal for every pixel which constitutes a stereo screen and it asks for a depth map in order to make resolution of a shade picture high, it will be influenced of the quantizing noise by this quantization error. Consequently, there was a case where judgment of the existence of the body for asking for a depth map was mistaken. Especially, on the edge (edge portion) of the picture of the body in a screen, the influence of a quantizing noise was remarkable.
[0006] For this reason, realization of the equipment and the method of judging objective existence with a sufficient precision was desired.
[0007]
[Means for Solving the Problem]
(1st invention) According to the body existence-or-nonexistence judgment equipment of the 1st invention concerning this application The corresponding-points search section which searches the bottom of two or more conditions for the pixel which becomes the corresponding points between each

picture, respectively, and extracts it from a stereo picture, The agreement corresponding-points extraction section from which the phase contrast of the pixel of the corresponding points concerned extracts equal corresponding points as agreement corresponding points substantially also under two or more conditions among corresponding points, It has the body existence-or-nonexistence judgment section judged that a body exists in the distance equivalent to the phase contrast which has the threshold calculation section which computes a threshold by carrying out statistics processing of the frequency of occurrence for every phase contrast of agreement corresponding points, and the frequency of occurrence higher than a threshold, and is characterized by the bird clapper.

[0008] (2nd invention) According to the body existence-or-nonexistence judgment method of the 2nd invention concerning this application, again Search the bottom of two or more conditions for the pixel which becomes the corresponding points between each picture, respectively, and it is extracted from a stereo picture. The phase contrast of the pixel of the corresponding points concerned extracts equal corresponding points as agreement corresponding points substantially also under two or more conditions among corresponding points. Statistics processing of the frequency of occurrence for every phase contrast of agreement corresponding points is carried out, and a threshold is computed and it is characterized by judging that a body exists in the distance equivalent to the phase contrast which has the frequency of occurrence higher than a threshold.

[0009] In addition, with phase contrast, when there are corresponding points on the same epipolar line of a stereo picture on either side, it is given here with the difference of the pixel number of the pixel of the corresponding points concerned in a left-hand side stereo picture, and the pixel number of the corresponding points concerned in a right-hand side stereo picture. It is expressed with the number at the time of giving a number one by one from the pixel at the left end of for example, each stereo screen (or right end) a pixel number here. Therefore, phase contrast becomes small, so that the distance from a camera to a body is far, and on the other hand, phase contrast becomes large, so that distance is near. For this reason, phase contrast can express distance substantially. For example, phase contrast D is convertible into Distance Z with the following (1) formula.

[0010] $Z = B \cdot F/D \ldots (1)$

However, B expresses the distance between cameras on either side, and F expresses the focal distance of a camera.

[0011]

[Embodiments of the Invention] Hereafter, with reference to a drawing, the body existence-or-nonexistence judgment equipment of the 1st invention concerning this application and the body existence-or-nonexistence judgment method of the 2nd invention are explained collectively. In addition, the drawing to refer to has shown the size, configuration, and arrangement relation of each constituent roughly to the grade which can understand these invention. Therefore, these invention is not limited only to the example of illustration.

[0012] (composition of equipment) The functional block diagram of the body existence-or-nonexistence judgment equipment of the gestalt of this operation is shown in drawing 1 . This equipment The left camera 10, the right camera 12, the corresponding-points search section 14, the search conditioning section 16, the 1st left corresponding-points memory (in drawing 1 , it is written as the 1st left memory) 18, the 1st right corresponding-points memory (in drawing 1 , it is written as the 1st right memory) 20, the 2nd left corresponding-points memory 22 (in drawing 1 , it is written as the 2nd left memory), It has the 2nd right corresponding-points memory (in drawing 1 , it is written as the 2nd right memory) 24, the left agreement corresponding-points extraction section 26, the right agreement corresponding-points extraction section 28, the left agreement corresponding-points memory 30, the right agreement corresponding-points memory 32, the left threshold calculation section 34, the right threshold calculation section 36, and the body existence-or-nonexistence judgment section 38.

[0013] This left camera 10 and the right camera 12 are for picturizing a stereo picture.

[0014] Moreover, this corresponding-points search section 14 is for searching the bottom of two or more conditions for the pixel which becomes the corresponding points in each picture, and extracting it from the stereo picture which consists of a right picture picturized with the left picture and the right camera 12

which were picturized with the left camera 10, respectively. Moreover, the search conditioning section 16 is for changing a setup of two or more conditions (here conditions 1 and conditions 2) in corresponding-points search.

[0015] Moreover, this 1st left corresponding-points memory 18 is for storing the coordinate (for example, pixel number) of the pixel of the corresponding points in a left picture extracted under conditions 1 (storage). Moreover, the 1st right corresponding-points memory 20 is for storing the coordinate of the pixel of the corresponding points in a right picture extracted under conditions 1. Moreover, the 2nd left corresponding-points memory 22 is for storing the coordinate of the pixel of the corresponding points in a left picture extracted under the conditions 2 in a left picture. The 2nd right corresponding-points memory 24 stores the coordinate of the pixel of the corresponding points in a right picture extracted under conditions 2.

[0016] Moreover, this left agreement corresponding-points extraction section 26 is for phase contrast extracting equal corresponding points as agreement corresponding points substantially under both conditions among the corresponding points in a left picture extracted under the 1st condition and the 2nd conditions, respectively. Moreover, it is for phase contrast extracting equal corresponding points as agreement corresponding points substantially under both conditions among the corresponding points in a right picture extracted, respectively under the right agreement corresponding-points extraction section 28, the 1st condition, and the 2nd conditions.

[0017] Moreover, it is for storing the agreement corresponding points extracted in this left agreement corresponding-points memory 30 and the left agreement corresponding-points extraction section 26. Moreover, the right agreement corresponding-points memory 32 is for storing the agreement corresponding points extracted in the right agreement corresponding points 28.

[0018] Moreover, this left threshold calculation section 34 is for computing a threshold by carrying out statistics processing of the frequency of occurrence for every phase contrast of the agreement corresponding points extracted in the left agreement corresponding-points extraction section 26. Moreover, this right threshold calculation section 36 is for computing a threshold by carrying out statistics processing of the frequency of occurrence for every phase contrast of the agreement corresponding points extracted in the right agreement corresponding-points extraction section 28.

[0019] Moreover, this body existence-or-nonexistence judgment section 38 is for judging that a body exists in the distance equivalent to the phase contrast which has the frequency of occurrence higher than a threshold.

[0020] (operation) Next, with reference to drawing 2 , the example of the body existence-or-nonexistence judgment method of the gestalt of this operation is explained. Drawing 2 is a flow chart with which explanation of the body existence-or-nonexistence judgment method is presented.

[0021] (a) First, picturize a photographic subject with the left camera 10 and the right camera 12, and incorporate a stereo picture.

[0022] (b1) Next, in the corresponding-points search section 14, the feature values, such as a shade, are compared, the bottom of conditions 1 is searched for the pixel which becomes the corresponding points in each picture from the stereo picture which consists of a right picture picturized with the left picture and the right camera 12 which were picturized with the left camera 10, and it is extracted.

[0023] (c1) next, the corresponding points extracted under conditions 1 -- the [the 1st left corresponding-points memory 18 and] -- it stores in 1 right corresponding-points memory 20, respectively

[0024] The example of a ** type of the phase contrast picture of the corresponding points obtained as a result of the search here of the corresponding points under conditions 1 to (A) of drawing 3 and (B) is shown. The left phase contrast picture of the corresponding points obtained from the left picture by (A) of drawing 3 is shown, and the right phase contrast picture acquired from the right picture by (B) of drawing 3 is shown. A phase contrast picture shows phase contrast only to the position of the pixel of the extracted corresponding points. Moreover, the same sign (alphabet) is given to the corresponding points in a phase contrast picture on either side. Moreover, a photographic subject exists in the field surrounded with the dashed line shown by S in a phase contrast picture on either side. This photographic

subject exists in the distance equivalent to phase contrast 3. This phase contrast is expressed with the difference of the pixel number of the corresponding points in a phase contrast picture on either side. Here, phase contrast is explained with reference to drawing 4 . The epipolar line I of a right-and-left picture is shown in (A) of drawing 4 . This epipolar line I is equivalent to the epipolar line I of (A) of drawing 3 . And the enlarged view of this epipolar line I is shown in (B) of drawing 4 . Here, the pixel number is attached sequentially from the pixel of the left-hand side in a picture. The pixel of the left-hand side pixel number 8 and the pixel of the right-hand side pixel number 5 have become corresponding points mutually among epipolar lines I. Since the difference of a pixel number is 8-5-3, the phase contrast of these corresponding points is 3. Moreover, the pixel of the left-hand side pixel number 10 and the pixel of the right-hand side pixel number 9 have become corresponding points mutually among epipolar lines I. Since the difference of this pixel number is 10-9=1, this corresponding-points phase contrast is 1. And in (B) of drawing 4 , the phase contrast of the corresponding points is displayed on the grid showing the pixel of each corresponding points. Moreover, the phase contrast of the corresponding points is similarly expressed to the grid of each corresponding points as the phase contrast picture shown in (A) of drawing 3 .

[0025] And under conditions 1, as shown in (A) of drawing 3 , within the limits of the photographic subject which shows by S, the corresponding points a, b, c, and d of phase contrast 3 are extracted, the corresponding points e and f of phase contrast 1 are extracted to the conservative field of a picture, and the corresponding points g and h of phase contrast 5 are extracted to the field of the lower approach of a picture.

[0026] (b2) The bottom of conditions 2 is searched for the pixel which becomes the corresponding points in each picture, and it is extracted from the stereo picture which consists of a right picture picturized in the corresponding-points search section 14 again with the left picture and the right camera 12 which were picturized with the left camera 10. In addition, a setup of conditions 1 and conditions 2 is changed by the search conditioning section 16.

[0027] (c2) next, the corresponding points extracted under conditions 2 -- the [the 2nd left corresponding-points memory 22 and] -- it stores in 2 right corresponding-points memory 24, respectively

[0028] The example of a ** type of the phase contrast picture of the corresponding points obtained as a result of the search here of the corresponding points under conditions 2 to (C) of drawing 3 and (D) is shown. The left phase contrast picture of the corresponding points obtained from the left picture by (C) of drawing 3 is shown, and the right phase contrast picture acquired from the right picture at (D) of drawing 3 is shown. A phase contrast picture shows phase contrast only to the position of the pixel of the extracted corresponding points. Moreover, the same sign (alphabet) is given to the corresponding points in a phase contrast picture on either side.

[0029] Under conditions 2, as shown in (B) of drawing 3 , the corresponding points e and f of the corresponding-points j phase contrast 1 of phase contrast 2 are extracted to the field of the corresponding points i of the phase contrast 1 of the field at the upper left of a picture, and the lower twist of a picture other than the corresponding points a, b, c, and d of phase contrast 3, and the corresponding points g and h of phase contrast 5 are extracted to the field of the lower twist of a picture.

[0030] In addition, in search of corresponding points, suitable methods conventionally arbitrary [from] among the well-known methods can be used. For example, a method given in reference: "Information Processing Society of Japan research report valve flow coefficient 70-3pp.15-22 1991.1.24" can be used. The relaxation (the multiplex scale method) of a multiplex scale is used, parallax is presumed repetitively, and this method is searched for the corresponding points of a pixel, in order to reduce the incorrect correspondence by the local minimum in investigating correspondence of each pixel on the epipolar line of a picture on either side, and searching for corresponding points. By the multiplex scale method, using a pyramid type data structure, repeated calculation is performed from coarse resolution to fine resolution, and processing is advanced.

[0031] (d) Next, read the corresponding points stored in each corresponding-points memory, and phase contrast extracts equal corresponding points as agreement corresponding points substantially under both

conditions in the left agreement corresponding-points extraction section 26 first among the corresponding points in a left picture extracted under the 1st condition and the 2nd conditions, respectively. Moreover, in the right agreement corresponding-points extraction section 28, phase contrast extracts equal corresponding points as agreement corresponding points substantially under both conditions among the corresponding points in a right picture extracted under the 1st condition and the 2nd conditions, respectively.

[0032] (e) Next, store in the left agreement corresponding-points memory 30 the agreement corresponding points extracted in the left agreement corresponding-points extraction section 26, and, on the other hand, store in the right agreement corresponding-points memory 32 the agreement corresponding points extracted in the right agreement corresponding-points extraction section 28.

[0033] Here, the example of a ** type of the agreement phase contrast picture of the agreement corresponding points extracted by (A) of drawing 5 and (B) is shown. (A) of drawing 5 shows the left agreement phase contrast picture acquired from the left phase contrast picture of (A) of drawing 3 , and (C), and (B) of drawing 5 shows the right agreement phase contrast picture acquired from the right phase contrast picture of (B) of drawing 3 , and (D). Only corresponding-points a-d and corresponding points e and f on a photographic subject S are extracted as agreement corresponding points which are corresponding points with an agreement phase contrast picture [on either side] common to each conditions. Therefore, the corresponding points i and j shown in (C) of the corresponding points g and h shown in (A) of drawing 3 and the phase contrast picture under the conditions 1 of (B) and drawing 3 and the phase contrast picture under the conditions 2 of (D) are deleted as a correspondence unknown point (j) by the agreement phase contrast picture of (A) of drawing 5 , and (B).

[0034] Thus, corresponding points are detected under two or more mutually different conditions, and only the agreement corresponding points used as common class are extracted in a set of the corresponding points obtained for every conditions as the right corresponding points (namely, corresponding points which are not incorrect correspondence) (it calls taking agreement hereafter). On the other hand, the corresponding points used as common class consider as a correspondence unknown point (j), and are deleted from a phase contrast picture. Consequently, removal of incorrect correspondence of corresponding points can be aimed at.

[0035] As an example of conditions 1 and conditions 2, two gradation which is mutually different about this shade extracts corresponding points as for example, a feature value paying attention to the shade of a picture. The pixels which it is the pixels on the same epipolar line of a subject-copy image on either side, and a concentration difference specifically becomes from the subject-copy image of the right and left obtained as a shade picture of condition 1256 gradation below a predetermined threshold first are detected as corresponding points. Next, the pixels which it is the pixels on the same epipolar line of a subject-copy image on either side, and a concentration difference becomes from the subject-copy image of the right and left obtained as a shade picture of 16 gradation of conditions 2 below a predetermined threshold are detected as corresponding points. And the corresponding points used as the common class of a set of the corresponding points detected under 256 gradation as conditions 1 and a set of the corresponding points detected under 16 gradation as conditions 2 are detected as the right corresponding points.

[0036] Moreover, if other examples of conditions 1 and conditions 2 are given, corresponding points will be detected for every color about the concentration of red, green, and each blue color by making a subject-copy image on either side into a color picture. In this case, the case of red corresponds [conditions 2 and the case of being blue] to conditions 1, and the case of being green corresponds to conditions 3, respectively. In a set of the corresponding points detected for every color, the corresponding points used as the common class in each color are detected as the right corresponding points.

[0037] Specifically, as conditions 1, paying attention to red concentration, it is the pixels on the same epipolar line of a subject-copy image on either side, and the pixels which a red concentration difference becomes below a predetermined threshold are first detected as corresponding points. Next, paying attention to the green concentration as conditions 2, the pixels which a green concentration difference

becomes below a predetermined threshold are detected as corresponding points like red. Furthermore, paying attention to the blue concentration as conditions 3, the pixels which a blue concentration difference becomes below a predetermined threshold are detected as corresponding points like red. And in a set of the corresponding points detected under conditions 1, a set of the corresponding points detected under conditions 2, and a set of the corresponding points detected under conditions 3, the corresponding points used as common class are detected as the right corresponding points.

[0038] Thus, in this invention, agreement corresponding points are extracted in advance of calculation of a threshold. Consequently, the rate dealing with incorrect included in the corresponding points (agreement corresponding points) set as the object of statistics processing can be reduced. For this reason, in case a threshold is computed by carrying out statistics processing, a threshold can suppress a bird clapper to an unsuitable value under the influence of incorrect correspondence. Therefore, calculation of a suitable threshold according to the extraction situation of corresponding points can be aimed at.

[0039] In addition, although only giving a fixed value as a threshold is also considered, the suitable threshold for body existence-or-nonexistence judgment changes greatly with photographic subjects. For this reason, in having made the threshold into the fixed value, the case where body existence-or-nonexistence judgment cannot carry out appropriately may happen for some photographic subjects. In invention concerning this point and this application, since the threshold is computed by statistics processing so that it may mention later, it becomes possible to judge objective existence or nonexistence using a suitable threshold for every picture of a processing object.

[0040] (f) Next, compute a threshold in the left threshold calculation section 34 and the right threshold calculation section 36 by carrying out statistics processing of the frequency of occurrence for every phase contrast of agreement corresponding points. in addition, a threshold -- right and left -- you may use what doubled and processed the picture of the thing computed in one of the threshold calculation sections, or both right and left, and was carried out three sorts moreover, the ** for which a threshold is not aimed at a full screen in statistics processing again -- some screens -- it is good only for a field

[0041] Here, with reference to drawing 6 , as a threshold, the standard deviation sigma of the frequency of occurrence in each phase contrast is computed, and the example using the value which deducted this standard deviation sigma from the maximum frequency of occurrence is explained. Drawing 6 is a graph with which explanation of a distribution of the frequency of occurrence for every phase contrast is presented, and is the graph which made the bar graph the frequency of occurrence (it is also called the appearance number) of the pixel for every phase contrast, and arranged it in order of the frequency of occurrence. In accordance with the horizontal axis of this graph, the value of phase contrast is shown for every bar graph, and the vertical axis of a graph expresses the frequency of occurrence.

[0042] it is shown in the graph of drawing 6 -- as -- the bar graph of the 5000 appearance numbers of phase contrast 100, the bar graph of the 4000 appearance numbers of phase contrast 50, the bar graph of the 1000 frequencies of occurrence of phase contrast 120, and the 500 appearance numbers of phase contrast 60 -- it is *********(ing) And the standard deviation sigma which computed these appearance numbers by having carried out statistics processing becomes 1916 pieces. And let 3084 values which deducted standard deviation sigma from the maximum appearance number 5000 be thresholds. Moreover, an alternate long and short dash line II shows the appearance number of a threshold (3084 pieces) among drawing 6 .

[0043] (g) And in (h), next the body existence-or-nonexistence judgment section 38, it is judged that a body exists in the distance in which frequency of occurrence is equivalent to phase contrast higher than a threshold.

[0044] For example, phase contrast extracts the corresponding points of 100 and 50, respectively as agreement corresponding points which have phase contrast with the frequency of occurrence higher than the example shown in drawing 6 , and a threshold (3084 pieces). And it is judged that a photographic subject exists in the distance equivalent to the phase contrast of these extracted corresponding points.

[0045] Moreover, in the case of the agreement phase contrast picture shown in (A) of above-mentioned drawing 5 , and (B) Supposing a threshold becomes three pieces as a result of statistics processing, for

example, the corresponding points of phase contrast 3 a, b, c, and d -- on the other hand, since the corresponding points of phase contrast 1 are two pieces, e and f, only the corresponding points of phase contrast 3 are extracted and four corresponding points e and f of phase contrast 1 are removed as a correspondence unknown point Thus, the output phase contrast picture imposed on the sieve with the threshold is shown in (C) of drawing 5 , and (D). (C) of drawing 5 is the left output phase contrast picture acquired from the left agreement phase contrast picture, and, on the other hand, (D) of drawing 5 is the right output phase contrast picture acquired from the right agreement phase contrast picture.

[0046] (i) Next, the result of body existence-or-nonexistence judgment is outputted. In an output, you may output an output phase contrast picture as shown in (C) of drawing 5 , and (D) as it is, for example. Moreover, you may output a detection result by the detection result output unit. When a body exists in a fixed range for example, it is good for a detection result output unit to give the information function which emits the alarm by sound or light. Moreover, if the detection result output unit which has this information function is prepared, the body existence-or-nonexistence judgment equipment of this invention can also be used as supervisory equipment.

[0047] Moreover, in a stereo picture, if a mark king is performed making bright or dark the brightness of the pixel of the phase contrast judged that a body exists, and displaying it rather than the brightness of other pixels, or by displaying the judged pixel by the specific color, directions of objective existence can be clarified.

[0048] Moreover, compared with the above-mentioned conventional example, distance detection of a photographic subject can be carried out by existence-or-nonexistence judgment of a body in all directions for every pixel over all the scanning lines by this invention to a full screen. For this reason, the distance detection by which the resolution of a shade picture and a direction are not fixed, for example is attained.

[0049] Although the gestalt of operation mentioned above explained only the example which constituted these invention from specific conditions, these invention can perform many change and deformation. For example, although the value which deducted standard deviation sigma from the maximum frequency of occurrence as a threshold was used with the gestalt of operation mentioned above, in these invention, a threshold is not limited to this and can use the suitable value computed by carrying out statistics processing of the distribution of the frequency of occurrence for every phase contrast of corresponding points. For example, it can consider as the value which carried out statistics processing of the distribution of the frequency of occurrence for every phase contrast of corresponding points, and also let the numeric value using 2sigma or 3sigma be a threshold. Furthermore, it is not a normal distribution but chi 2 as a distribution of the frequency of occurrence for every phase contrast of corresponding points. A distribution may be assumed and statistics processing may be performed.

[0050] Moreover, although the gestalt of operation mentioned above explained the example of the body existence-or-nonexistence judgment in the stereo picture acquired with the camera of two right and left, you may apply these invention to the stereo picture picturized with the camera of three or more a large number.

[0051] Moreover, although memory is displayed as independent functional block, you may make memory build in each part of the corresponding-points search section and the agreement corresponding-points extraction section with the gestalt of operation mentioned above, respectively.

[0052] Moreover, with the gestalt of operation mentioned above, although the threshold calculation section was prepared according to the right-and-left individual, the 1st invention appearance may prepare the threshold calculation section of one right and left in all.

[0053] Moreover, although counting of the frequency of occurrence was carried out for every phase contrast, for example, the statistics processing section may be prepared individually, and statistics processing of the frequency of occurrence etc. may be made to perform by the 1st invention in the body existence-or-nonexistence judgment section with the gestalt of operation mentioned above here in addition to the body existence-or-nonexistence judgment section.

[0054] moreover, although corresponding points with equal phase contrast were extracted under different conditions in extracting agreement corresponding points with the gestalt of operation

mentioned above, phase contrast is substantial in this invention -- even when the phase contrast under conditions different [that what is necessary is just equally] depending on the precision needed has a difference, it can choose as agreement corresponding points

[0055]

[Effect of the Invention] According to invention concerning this application, the phase contrast of the corresponding points concerned extracted under two or more mutually different conditions among the corresponding points of a stereo picture, respectively extracts equal corresponding points (namely, corresponding points used as common class) as agreement corresponding points substantially mutually. Consequently, reduction of the rate of incorrect correspondence can be aimed at by aiming at removal of the pixel of incorrect correspondence out of corresponding points. If this is the corresponding points with the right corresponding points extracted by corresponding-points search, the phase contrast is because the probability which becomes equal substantially, without being based on the conditions of corresponding-points search is high, and on the other hand, in the case of mistaken corresponding when the conditions of corresponding-points search differ, it is because the probability that the phase contrast of the corresponding points differs is high.

[0056] Furthermore, in these invention, a threshold is computed by statistics processing. For this reason, compared with the case where it is not based on a picture as a threshold, but a fixed value is set up, it becomes possible to judge objective existence or nonexistence with a sufficient precision using a suitable threshold for every picture of a processing object.

[Translation done.]

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TECHNICAL FIELD

[The technical field to which invention belongs] This invention relates to the equipment and the method of judging existence of the existence of the body in a stereo picture from the distribution of the phase contrast of the phase contrast picture acquired by the stereo method.

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PRIOR ART

[Description of the Prior Art] An example of the equipment which measures the position where a body exists using the conventional stereo method is indicated by reference: "a picture lab, 1994.11, pp.65-67, and Japanese industrial publication." With the equipment of an indication in this reference, the distance from the camera of the body which divides a visual field in the 480 directions and exists in each direction is computed. And in order to reduce the amount sampled spatially in calculation of the distance and to plan a real-time operation, in each of a shade picture on either side, only the one scanning line is chosen every five, and the image data of five directions is extracted for every selected scanning line of this. And the corresponding points of a shade picture on either side are detected using the extracted image data, and an objective distance is computed based on the phase contrast of these corresponding points.

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EFFECT OF THE INVENTION

[Effect of the Invention] According to invention concerning this application, the phase contrast of the corresponding points concerned extracted under two or more mutually different conditions among the corresponding points of a stereo picture, respectively extracts equal corresponding points (namely, corresponding points used as common class) as agreement corresponding points substantially mutually. Consequently, reduction of the rate of incorrect correspondence can be aimed at by aiming at removal of the pixel of incorrect correspondence out of corresponding points. If this is the corresponding points with the right corresponding points extracted by corresponding-points search, the phase contrast is because the probability which becomes equal substantially, without being based on the conditions of corresponding-points search is high, and on the other hand, in the case of mistaken corresponding points, when the conditions of corresponding-points search differ, it is because the probability that the phase contrast of the corresponding points differs is high.
[0056] Furthermore, in these invention, a threshold is computed by statistics processing. For this reason, compared with the case where it is not based on a picture as a threshold, but a fixed value is set up, it becomes possible to judge objective existence or nonexistence with a sufficient precision using a suitable threshold for every picture of a processing object.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, with the conventional equipment mentioned above, an objective distance is computed only using the one scanning line among five. For this reason, it can only catch using as a rectangle pattern (block pattern) the body which exists all over a screen. Moreover, resolution of a shade picture cannot be made finer than this block pattern, either.
[0004] By the way, generally as an image pickup device of the camera of the right and left for acquiring a stereo picture, CCD (Charge Coupled Device) is used. The picture signal from CCD is digitized for signal processing, and is memorized. For this reason, the memorized picture signal contains the quantization error by digitization.
[0005] Consequently, if an objective distance is computed based on a picture signal for every pixel which constitutes a stereo screen and it asks for a depth map in order to make resolution of a shade picture high, it will be influenced of the quantizing noise by this quantization error. Consequently, there was a case where judgment of the existence of the body for asking for a depth map was mistaken. Especially, on the edge (edge portion) of the picture of the body in a screen, the influence of a quantizing noise was remarkable.
[0006] For this reason, realization of the equipment and the method of judging objective existence with a sufficient precision was desired.

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MEANS

[Means for Solving the Problem]
(1st invention) According to the body existence-or-nonexistence judgment equipment of the 1st invention concerning this application The corresponding-points search section which searches the bottom of two or more conditions for the pixel which becomes the corresponding points between each picture, respectively, and extracts it from a stereo picture, The agreement corresponding-points extraction section from which the phase contrast of the pixel of the corresponding points concerned extracts equal corresponding points as agreement corresponding points substantially also under two or more conditions among corresponding points, It has the body existence-or-nonexistence judgment section judged that a body exists in the distance equivalent to the phase contrast which has the threshold calculation section which computes a threshold by carrying out statistics processing of the frequency of occurrence for every phase contrast of agreement corresponding points, and the frequency of occurrence higher than a threshold, and is characterized by the bird clapper.
[0008] (2nd invention) According to the body existence-or-nonexistence judgment method of the 2nd invention concerning this application, again Search the bottom of two or more conditions for the pixel which becomes the corresponding points between each picture, respectively, and it is extracted from a stereo picture. The phase contrast of the pixel of the corresponding points concerned extracts equal corresponding points as agreement corresponding points substantially also under two or more conditions among corresponding points. Statistics processing of the frequency of occurrence for every phase contrast of agreement corresponding points is carried out, and a threshold is computed and it is characterized by judging that a body exists in the distance equivalent to the phase contrast which has the frequency of occurrence higher than a threshold.
[0009] In addition, with phase contrast, when there are corresponding points on the same epipolar line of a stereo picture on either side, it is given here with the difference of the pixel number of the pixel of the corresponding points concerned in a left-hand side stereo picture, and the pixel number of the corresponding points concerned in a right-hand side stereo picture. It is expressed with the number at the time of giving a number one by one from the pixel at the left end of for example, each stereo screen (or right end) a pixel number here. Therefore, phase contrast becomes small, so that the distance from a camera to a body is far, and on the other hand, phase contrast becomes large, so that distance is near. For this reason, phase contrast can express distance substantially. For example, phase contrast D is convertible into Distance Z with the following (1) formula.
[0010] $Z=B \cdot F/D$ ... (1)
However, B expresses the distance between cameras on either side, and F expresses the focal distance of a camera.
[0011]
[Embodiments of the Invention] Hereafter, with reference to a drawing, the body existence-or-nonexistence judgment equipment of the 1st invention concerning this application and the body existence-or-nonexistence judgment method of the 2nd invention are explained collectively. In addition, the drawing to refer to has shown the size, configuration, and arrangement relation of each constituent

roughly to the grade which can understand these invention. Therefore, these invention is not limited only to the example of illustration.

[0012] (composition of equipment) The functional block diagram of the body existence-or-nonexistence judgment equipment of the gestalt of this operation is shown in drawing 1 . This equipment The left camera 10, the right camera 12, the corresponding-points search section 14, the search conditioning section 16, the 1st left corresponding-points memory (in drawing 1 , it is written as the 1st left memory) 18, the 1st right corresponding-points memory (in drawing 1 , it is written as the 1st right memory) 20, the 2nd left corresponding-points memory 22 (in drawing 1 , it is written as the 2nd left memory), It has the 2nd right corresponding-points memory (in drawing 1 , it is written as the 2nd right memory) 24, the left agreement corresponding-points extraction section 26, the right agreement corresponding-points extraction section 28, the left agreement corresponding-points memory 30, the right agreement corresponding-points memory 32, the left threshold calculation section 34, the right threshold calculation section 36, and the body existence-or-nonexistence judgment section 38.

[0013] This left camera 10 and the right camera 12 are for picturizing a stereo picture.

[0014] Moreover, this corresponding-points search section 14 is for searching the bottom of two or more conditions for the pixel which becomes the corresponding points in each picture, and extracting it from the stereo picture which consists of a right picture picturized with the left picture and the right camera 12 which were picturized with the left camera 10, respectively. Moreover, the search conditioning section 16 is for changing a setup of two or more conditions (here conditions 1 and conditions 2) in corresponding-points search.

[0015] Moreover, this 1st left corresponding-points memory 18 is for storing the coordinate (for example, pixel number) of the pixel of the corresponding points in a left picture extracted under conditions 1 (storage). Moreover, the 1st right corresponding-points memory 20 is for storing the coordinate of the pixel of the corresponding points in a right picture extracted under conditions 1. Moreover, the 2nd left corresponding-points memory 22 is for storing the coordinate of the pixel of the corresponding points in a left picture extracted under the conditions 2 in a left picture. The 2nd right corresponding-points memory 24 stores the coordinate of the pixel of the corresponding points in a right picture extracted under conditions 2.

[0016] Moreover, this left agreement corresponding-points extraction section 26 is for phase contrast extracting equal corresponding points as agreement corresponding points substantially under both conditions among the corresponding points in a left picture extracted under the 1st condition and the 2nd conditions, respectively. Moreover, it is for phase contrast extracting equal corresponding points as agreement corresponding points substantially under both conditions among the corresponding points in a right picture extracted, respectively under the right agreement corresponding-points extraction section 28, the 1st condition, and the 2nd conditions.

[0017] Moreover, it is for storing the agreement corresponding points extracted in this left agreement corresponding-points memory 30 and the left agreement corresponding-points extraction section 26. Moreover, the right agreement corresponding-points memory 32 is for storing the agreement corresponding points extracted in the right agreement corresponding points 28.

[0018] Moreover, this left threshold calculation section 34 is for computing a threshold by carrying out statistics processing of the frequency of occurrence for every phase contrast of the agreement corresponding points extracted in the left agreement corresponding-points extraction section 26. Moreover, this right threshold calculation section 36 is for computing a threshold by carrying out statistics processing of the frequency of occurrence for every phase contrast of the agreement corresponding points extracted in the right agreement corresponding-points extraction section 28.

[0019] Moreover, this body existence-or-nonexistence judgment section 38 is for judging that a body exists in the distance equivalent to the phase contrast which has the frequency of occurrence higher than a threshold.

[0020] (operation) Next, with reference to drawing 2 , the example of the body existence-or-nonexistence judgment method of the gestalt of this operation is explained. Drawing 2 is a flow chart with which explanation of the body existence-or-nonexistence judgment method is presented.

[0021] (a) First, picturize a photographic subject with the left camera 10 and the right camera 12, and incorporate a stereo picture.

[0022] (b1) Next, in the corresponding-points search section 14, the feature values, such as a shade, are compared, the bottom of conditions 1 is searched for the pixel which becomes the corresponding points in each picture from the stereo picture which consists of a right picture picturized with the left picture and the right camera 12 which were picturized with the left camera 10, and it is extracted.

[0023] (c1) next, the corresponding points extracted under conditions 1 -- the [the 1st left corresponding-points memory 18 and] -- it stores in 1 right corresponding-points memory 20, respectively

[0024] The example of a ** type of the phase contrast picture of the corresponding points obtained as a result of the search here of the corresponding points under conditions 1 to (A) of drawing 3 and (B) is shown. The left phase contrast picture of the corresponding points obtained from the left picture by (A) of drawing 3 is shown, and the right phase contrast picture acquired from the right picture by (B) of drawing 3 is shown. A phase contrast picture shows phase contrast only to the position of the pixel of the extracted corresponding points. Moreover, the same sign (alphabet) is given to the corresponding points in a phase contrast picture on either side. Moreover, a photographic subject exists in the field surrounded with the dashed line shown by S in a phase contrast picture on either side. This photographic subject exists in the distance equivalent to phase contrast 3. This phase contrast is expressed with the difference of the pixel number of the corresponding points in a phase contrast picture on either side. Here, phase contrast is explained with reference to drawing 4 . The epipolar line I of a right-and-left picture is shown in (A) of drawing 4 . This epipolar line I is equivalent to the epipolar line I of (A) of drawing 3 . And the enlarged view of this epipolar line I is shown in (B) of drawing 4 . Here, the pixel number is attached sequentially from the pixel of the left-hand side in a picture. The pixel of the left-hand side pixel number 8 and the pixel of the right-hand side pixel number 5 have become corresponding points mutually among epipolar lines I. Since the difference of a pixel number is 8-5-3, the phase contrast of these corresponding points is 3. Moreover, the pixel of the left-hand side pixel number 10 and the pixel of the right-hand side pixel number 9 have become corresponding points mutually among epipolar lines I. Since the difference of this pixel number is 10-9=1, this corresponding-points phase contrast is 1. And in (B) of drawing 4 , the phase contrast of the corresponding points is displayed on the grid showing the pixel of each corresponding points. Moreover, the phase contrast of the corresponding points is similarly expressed to the grid of each corresponding points as the phase contrast picture shown in (A) of drawing 3 .

[0025] And under conditions 1, as shown in (A) of drawing 3 , within the limits of the photographic subject which shows by S, the corresponding points a, b, c, and d of phase contrast 3 are extracted, the corresponding points e and f of phase contrast 1 are extracted to the conservative field of a picture, and the corresponding points g and h of phase contrast 5 are extracted to the field of the lower approach of a picture.

[0026] (b2) The bottom of conditions 2 is searched for the pixel which becomes the corresponding points in each picture, and it is extracted from the stereo picture which consists of a right picture picturized in the corresponding-points search section 14 again with the left picture and the right camera 12 which were picturized with the left camera 10. In addition, a setup of conditions 1 and conditions 2 is changed by the search conditioning section 16.

[0027] (c2) next, the corresponding points extracted under conditions 2 -- the [the 2nd left corresponding-points memory 22 and] -- it stores in 2 right corresponding-points memory 24, respectively

[0028] The example of a ** type of the phase contrast picture of the corresponding points obtained as a result of the search here of the corresponding points under conditions 2 to (C) of drawing 3 and (D) is shown. The left phase contrast picture of the corresponding points obtained from the left picture by (C) of drawing 3 is shown, and the right phase contrast picture acquired from the right picture at (D) of drawing 3 is shown. A phase contrast picture shows phase contrast only to the position of the pixel of the extracted corresponding points. Moreover, the same sign (alphabet) is given to the corresponding

points in a phase contrast picture on either side.

[0029] Under conditions 2, as shown in (B) of drawing 3 , the corresponding points e and f of the corresponding-points j phase contrast 1 of phase contrast 2 are extracted to the field of the corresponding points i of the phase contrast 1 of the field at the upper left of a picture, and the lower twist of a picture other than the corresponding points a, b, c, and d of phase contrast 3, and the corresponding points g and h of phase contrast 5 are extracted to the field of the lower twist of a picture.

[0030] In addition, in search of corresponding points, suitable methods conventionally arbitrary [from] among the well-known methods can be used. For example, a method given in reference: "Information Processing Society of Japan research report valve flow coefficient 70-3pp.15-22 1991.1.24" can be used. The method (the multiplex scale method) of loosening a multiplex scale is used, parallax is presumed repetitively, and this method is searched for the corresponding points of a pixel, in order to reduce the incorrect correspondence by the local minimum in investigating correspondence of each pixel on the epipolar line of a picture on either side, and searching for corresponding points. By the multiplex scale method, using a pyramid type data structure, repeated calculation is performed from coarse resolution to fine resolution, and processing is advanced.

[0031] (d) Next, read the corresponding points stored in each corresponding-points memory, and phase contrast extracts equal corresponding points as agreement corresponding points substantially under both conditions in the left agreement corresponding-points extraction section 26 first among the corresponding points in a left picture extracted under the 1st condition and the 2nd conditions, respectively. Moreover, in the right agreement corresponding-points extraction section 28, phase contrast extracts equal corresponding points as agreement corresponding points substantially under both conditions among the corresponding points in a right picture extracted under the 1st condition and the 2nd conditions, respectively.

[0032] (e) Next, store in the left agreement corresponding-points memory 30 the agreement corresponding points extracted in the left agreement corresponding-points extraction section 26, and, on the other hand, store in the right agreement corresponding-points memory 32 the agreement corresponding points extracted in the right agreement corresponding-points extraction section 28.

[0033] Here, the example of a ** type of the agreement phase contrast picture of the agreement corresponding points extracted by (A) of drawing 5 and (B) is shown. (A) of drawing 5 shows the left agreement phase contrast picture acquired from the left phase contrast picture of (A) of drawing 3 , and (C), and (B) of drawing 5 shows the right agreement phase contrast picture acquired from the right phase contrast picture of (B) of drawing 3 , and (D). Only corresponding-points a-d and corresponding points e and f on a photographic subject S are extracted as agreement corresponding points which are corresponding points with an agreement phase contrast picture [on either side] common to each conditions. Therefore, the corresponding points i and j shown in (C) of the corresponding points g and h shown in (A) of drawing 3 and the phase contrast picture under the conditions 1 of (B) and drawing 3 and the phase contrast picture under the conditions 2 of (D) are deleted as a correspondence unknown point (j) by the agreement phase contrast picture of (A) of drawing 5 , and (B).

[0034] Thus, corresponding points are detected under two or more mutually different conditions, and only the agreement corresponding points used as common class are extracted in a set of the corresponding points obtained for every conditions as the right corresponding points (namely, corresponding points which are not incorrect correspondence) (it calls taking agreement hereafter). On the other hand, the corresponding points used as common class consider as a correspondence unknown point (j), and are deleted from a phase contrast picture. Consequently, removal of incorrect correspondence of corresponding points can be aimed at.

[0035] As an example of conditions 1 and conditions 2, two gradation which is mutually different about this shade extracts corresponding points as for example, a feature value paying attention to the shade of a picture. The pixels which it is the pixels on the same epipolar line of a subject-copy image on either side, and a concentration difference specifically becomes from the subject-copy image of the right and left obtained as a shade picture of condition 1256 gradation below a predetermined threshold first are detected as corresponding points. Next, the pixels which it is the pixels on the same epipolar line of a

subject-copy image on either side, and a concentration difference becomes from the subject-copy image of the right and left obtained as a shade picture of 16 gradation of conditions 2 below a predetermined threshold are detected as corresponding points. And the corresponding points used as the common class of a set of the corresponding points detected under 256 gradation as conditions 1 and a set of the corresponding points detected under 16 gradation as conditions 2 are detected as the right corresponding points.

[0036] Moreover, if other examples of conditions 1 and conditions 2 are given, corresponding points will be detected for every color about the concentration of red, green, and each blue color by making a subject-copy image on either side into a color picture. In this case, the case of red corresponds [conditions 2 and the case of being blue] to conditions 1, and the case of being green corresponds to conditions 3, respectively. In a set of the corresponding points detected for every color, the corresponding points used as the common class in each color are detected as the right corresponding points.

[0037] Specifically, as conditions 1, paying attention to red concentration, it is the pixels on the same epipolar line of a subject-copy image on either side, and the pixels which a red concentration difference becomes below a predetermined threshold are first detected as corresponding points. Next, paying attention to the green concentration as conditions 2, the pixels which a green concentration difference becomes below a predetermined threshold are detected as corresponding points like red. Furthermore, paying attention to the blue concentration as conditions 3, the pixels which a blue concentration difference becomes below a predetermined threshold are detected as corresponding points like red. And in a set of the corresponding points detected under conditions 1, a set of the corresponding points detected under conditions 2, and a set of the corresponding points detected under conditions 3, the corresponding points used as common class are detected as the right corresponding points.

[0038] Thus, in this invention, agreement corresponding points are extracted in advance of calculation of a threshold. Consequently, the rate dealing with incorrect included in the corresponding points (agreement corresponding points) set as the object of statistics processing can be reduced. For this reason, in case a threshold is computed by carrying out statistics processing, a threshold can suppress a bird clapper to an unsuitable value under the influence of incorrect correspondence. Therefore, calculation of a suitable threshold according to the extraction situation of corresponding points can be aimed at.

[0039] In addition, although only giving a fixed value as a threshold is also considered, the suitable threshold for body existence-or-nonexistence judgment changes greatly with photographic subjects. For this reason, in having made the threshold into the fixed value, the case where body existence-or-nonexistence judgment cannot carry out appropriately may happen for some photographic subjects. In invention concerning this point and this application, since the threshold is computed by statistics processing so that it may mention later, it becomes possible to judge objective existence or nonexistence using a suitable threshold for every picture of a processing object.

[0040] (f) Next, compute a threshold in the left threshold calculation section 34 and the right threshold calculation section 36 by carrying out statistics processing of the frequency of occurrence for every phase contrast of agreement corresponding points. in addition, a threshold -- right and left -- you may use what doubled and processed the picture of the thing computed in one of the threshold calculation sections, or both right and left, and was carried out three sorts moreover, the ** for which a threshold is not aimed at a full screen in statistics processing again -- some screens -- it is good only for a field

[0041] Here, with reference to drawing 6 , as a threshold, the standard deviation sigma of the frequency of occurrence in each phase contrast is computed, and the example using the value which deducted this standard deviation sigma from the maximum frequency of occurrence is explained. Drawing 6 is a graph with which explanation of a distribution of the frequency of occurrence for every phase contrast is presented, and is the graph which made the bar graph the frequency of occurrence (it is also called the appearance number) of the pixel for every phase contrast, and arranged it in order of the frequency of occurrence. In accordance with the horizontal axis of this graph, the value of phase contrast is shown for every bar graph, and the vertical axis of a graph expresses the frequency of occurrence.

[0042] it is shown in the graph of drawing 6 -- as -- the bar graph of the 5000 appearance numbers of phase contrast 100, the bar graph of the 4000 appearance numbers of phase contrast 50, the bar graph of the 1000 frequencies of occurrence of phase contrast 120, and the 500 appearance numbers of phase contrast 60 -- it is **********(ing) And the standard deviation sigma which computed these appearance numbers by having carried out statistics processing becomes 1916 pieces. And let 3084 values which deducted standard deviation sigma from the maximum appearance number 5000 be thresholds. Moreover, an alternate long and short dash line II shows the appearance number of a threshold (3084 pieces) among drawing 6 .

[0043] (g) And in (h), next the body existence-or-nonexistence judgment section 38, it is judged that a body exists in the distance in which frequency of occurrence is equivalent to phase contrast higher than a threshold.

[0044] For example, phase contrast extracts the corresponding points of 100 and 50, respectively as agreement corresponding points which have phase contrast with the frequency of occurrence higher than the example shown in drawing 6 , and a threshold (3084 pieces). And it is judged that a photographic subject exists in the distance equivalent to the phase contrast of these extracted corresponding points.

[0045] Moreover, in the case of the agreement phase contrast picture shown in (A) of above-mentioned drawing 5 , and (B) Supposing a threshold becomes three pieces as a result of statistics processing, for example, the corresponding points of phase contrast 3 a, b, c, and d -- on the other hand, since the corresponding points of phase contrast 1 are two pieces, e and f, only the corresponding points of phase contrast 3 are extracted and four corresponding points e and f of phase contrast 1 are removed as a correspondence unknown point Thus, the output phase contrast picture imposed on the sieve with the threshold is shown in (C) of drawing 5 , and (D). (C) of drawing 5 is the left output phase contrast picture acquired from the left agreement phase contrast picture, and, on the other hand, (D) of drawing 5 is the right output phase contrast picture acquired from the right agreement phase contrast picture.

[0046] (i) Next, the result of body existence-or-nonexistence judgment is outputted. In an output, you may output an output phase contrast picture as shown in (C) of drawing 5 , and (D) as it is, for example. Moreover, you may output a detection result by the detection result output unit. When a body exists in a fixed range for example, it is good for a detection result output unit to give the information function which emits the alarm by sound or light. Moreover, if the detection result output unit which has this information function is prepared, the body existence-or-nonexistence judgment equipment of this invention can also be used as supervisory equipment.

[0047] Moreover, in a stereo picture, if a mark king is performed making bright or dark the brightness of the pixel of the phase contrast judged that a body exists, and displaying it rather than the brightness of other pixels, or by displaying the judged pixel by the specific color, directions of objective existence can be clarified.

[0048] Moreover, compared with the above-mentioned conventional example, distance detection of a photographic subject can be carried out by existence-or-nonexistence judgment of a body in all directions for every pixel over all the scanning lines by this invention to a full screen. For this reason, the distance detection by which the resolution of a shade picture and a direction are not fixed, for example is attained.

[0049] Although the gestalt of operation mentioned above explained only the example which constituted these invention from specific conditions, these invention can perform many change and deformation. For example, although the value which deducted standard deviation sigma from the maximum frequency of occurrence as a threshold was used with the gestalt of operation mentioned above, in these invention, a threshold is not limited to this and can use the suitable value computed by carrying out statistics processing of the distribution of the frequency of occurrence for every phase contrast of corresponding points. For example, it can consider as the value which carried out statistics processing of the distribution of the frequency of occurrence for every phase contrast of corresponding points, and also let the numeric value using 2sigma or 3sigma be a threshold. Furthermore, it is not a normal distribution but chi 2 as a distribution of the frequency of occurrence for every phase contrast of corresponding points. A distribution may be assumed and statistics processing may be performed.

[0050] Moreover, although the gestalt of operation mentioned above explained the example of the body existence-or-nonexistence judgment in the stereo picture acquired with the camera of two right and left, you may apply these invention to the stereo picture picturized with the camera of three or more a large number.

[0051] Moreover, although memory is displayed as independent functional block, you may make memory build in each part of the corresponding-points search section and the agreement corresponding-points extraction section with the gestalt of operation mentioned above, respectively.

[0052] Moreover, with the gestalt of operation mentioned above, although the threshold calculation section was prepared according to the right-and-left individual, the 1st invention appearance may prepare the threshold calculation section of one right and left in all.

[0053] Moreover, although counting of the frequency of occurrence was carried out for every phase contrast, for example, the statistics processing section may be prepared individually, and statistics processing of the frequency of occurrence etc. may be made to perform by the 1st invention in the body existence-or-nonexistence judgment section with the gestalt of operation mentioned above here in addition to the body existence-or-nonexistence judgment section.

[0054] moreover, although corresponding points with equal phase contrast were extracted under different conditions in extracting agreement corresponding points with the gestalt of operation mentioned above, phase contrast is substantial in this invention -- even when the phase contrast under conditions different [that what is necessary is just equally] depending on the precision needed has a difference, it can choose as agreement corresponding points

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[Translation done.]

* NOTICES *

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1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] Body existence-or-nonexistence judgment equipment characterized by providing the following. The corresponding-points search section which searches the bottom of two or more conditions for the pixel which becomes the corresponding points between each picture, respectively, and extracts it from a stereo picture. The agreement corresponding-points extraction section from which the phase contrast of the pixel of the corresponding points concerned extracts equal corresponding points as agreement corresponding points substantially also under two or more conditions among the aforementioned corresponding points. The threshold calculation section which computes a threshold by carrying out statistics processing of the frequency of occurrence for every phase contrast of the aforementioned agreement corresponding points. The body existence-or-nonexistence judgment section judged that a body exists in the distance equivalent to the phase contrast which has the frequency of occurrence higher than the aforementioned threshold.
[Claim 2] Search the bottom of two or more conditions for the pixel which becomes the corresponding points between each picture, respectively, and it is extracted from a stereo picture. The phase contrast of the pixel of the corresponding points concerned extracts equal corresponding points as agreement corresponding points substantially also under two or more conditions among the aforementioned corresponding points. The body existence-or-nonexistence judgment method which carries out statistics processing of the frequency of occurrence for every phase contrast of the aforementioned agreement corresponding points, and is characterized by judging that a body exists in the distance equivalent to the phase contrast which computes a threshold and has the frequency of occurrence higher than the aforementioned threshold.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the functional block diagram with which explanation of the body existence-or-
nonexistence judgment equipment of this invention is presented.
[Drawing 2] It is the flow chart with which explanation of the body existence-or-nonexistence judgment
method of this invention is presented.
[Drawing 3] (B) is the right phase contrast picture acquired under conditions 1, (A) is the left phase
contrast picture acquired under conditions 1, and (D) is [(C) is the left phase contrast picture acquired
under conditions 2, and] the right phase contrast picture acquired under conditions 2.
[Drawing 4] (A) is explanatory drawing of an epipolar line and (B) is explanatory drawing of the phase
contrast of corresponding points.
[Drawing 5] (B) is a right agreement phase contrast picture, (A) is a left agreement phase contrast
picture, and (D) is [(C) is a left output phase contrast picture, and] a right output phase contrast picture.

[Drawing 6] It is the graph with which explanation of body existence-or-nonexistence judgment is
presented.
[Description of Notations]
10: Left camera
12: Right camera
14: Corresponding-points search section
16: Search conditioning section
18: The 1st left corresponding-points memory (the 1st left memory)
20: The 1st right corresponding-points memory (the 1st right memory)
22: The 2nd left corresponding-points memory (the 2nd left memory)
24: The 2nd right corresponding-points memory (the 2nd right memory)
26: Left agreement corresponding-points extraction section
28: Right agreement corresponding-points extraction section
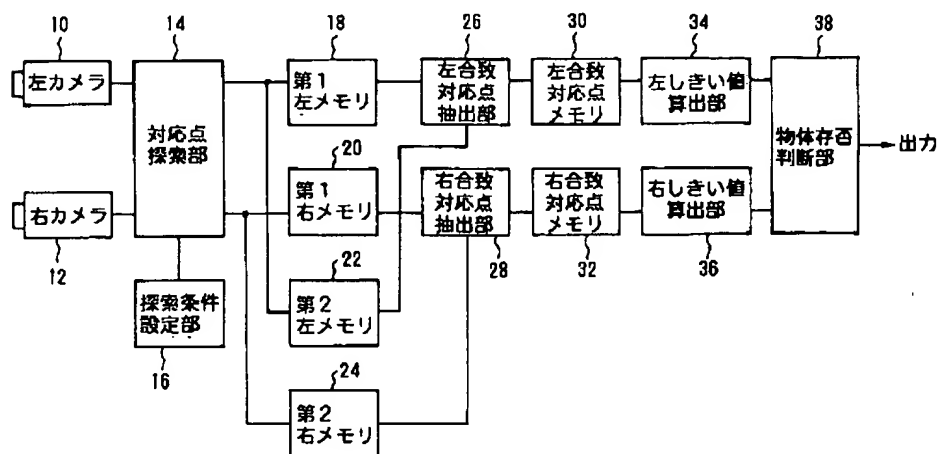30: Left agreement corresponding-points memory
32: Right agreement corresponding-points memory
34: Left threshold calculation section
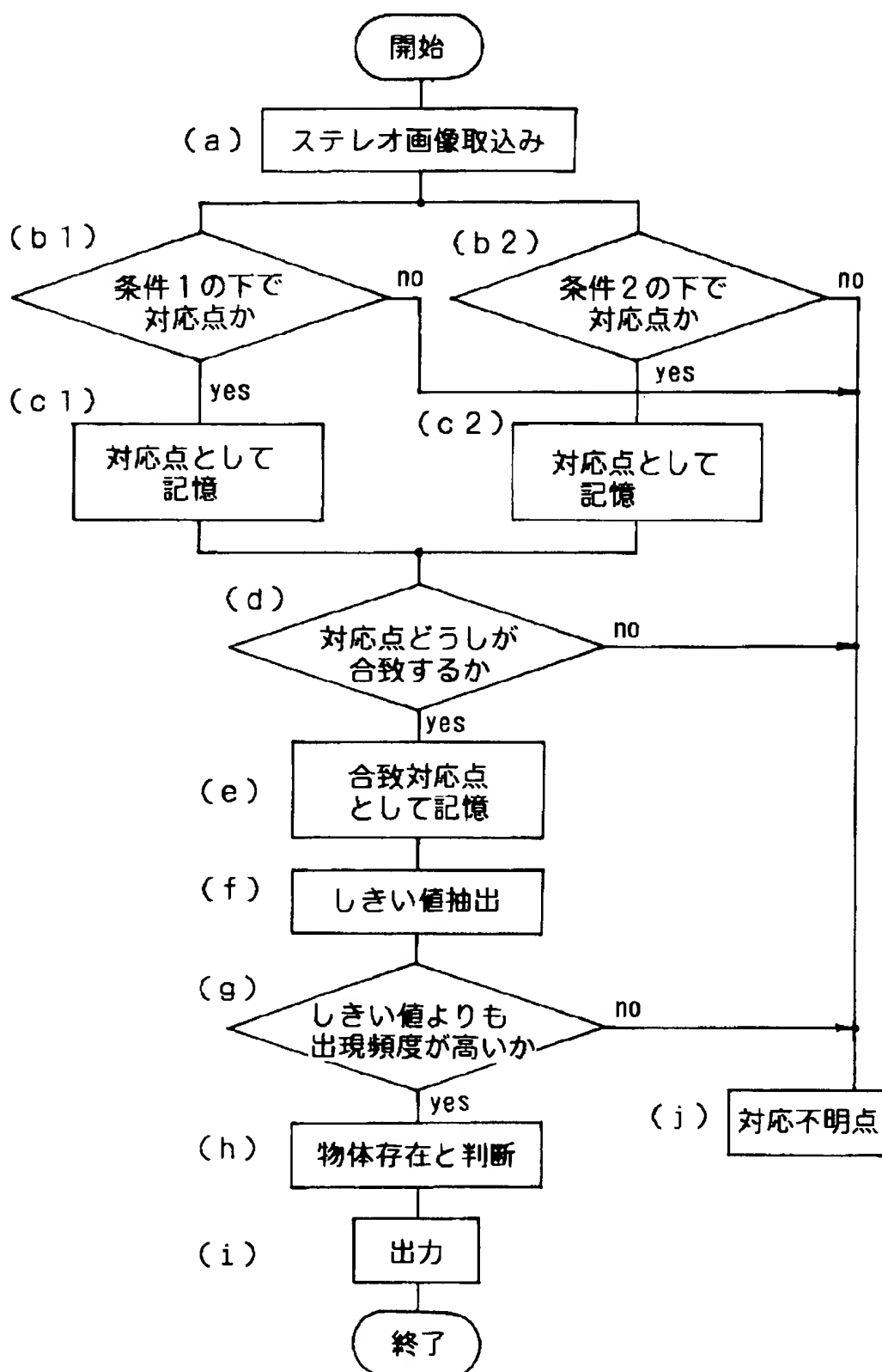36: Right threshold calculation section
38: Body existence-or-nonexistence judgment section
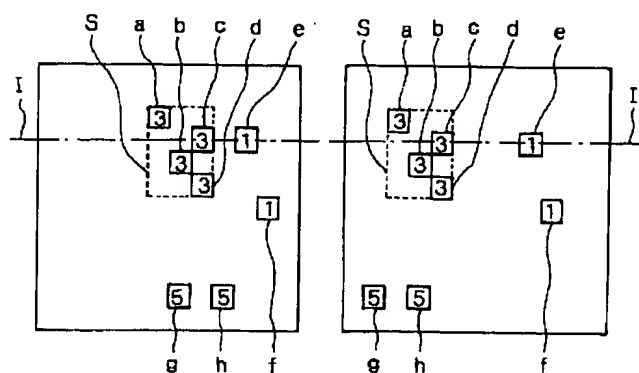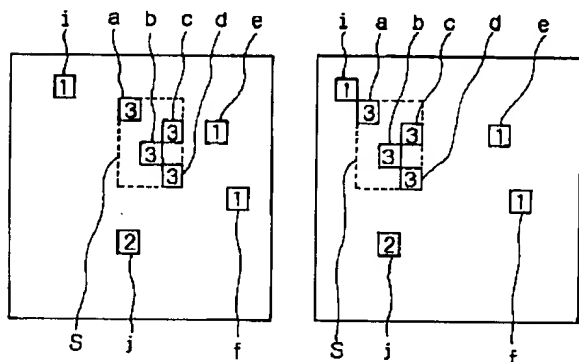

[Translation done.]

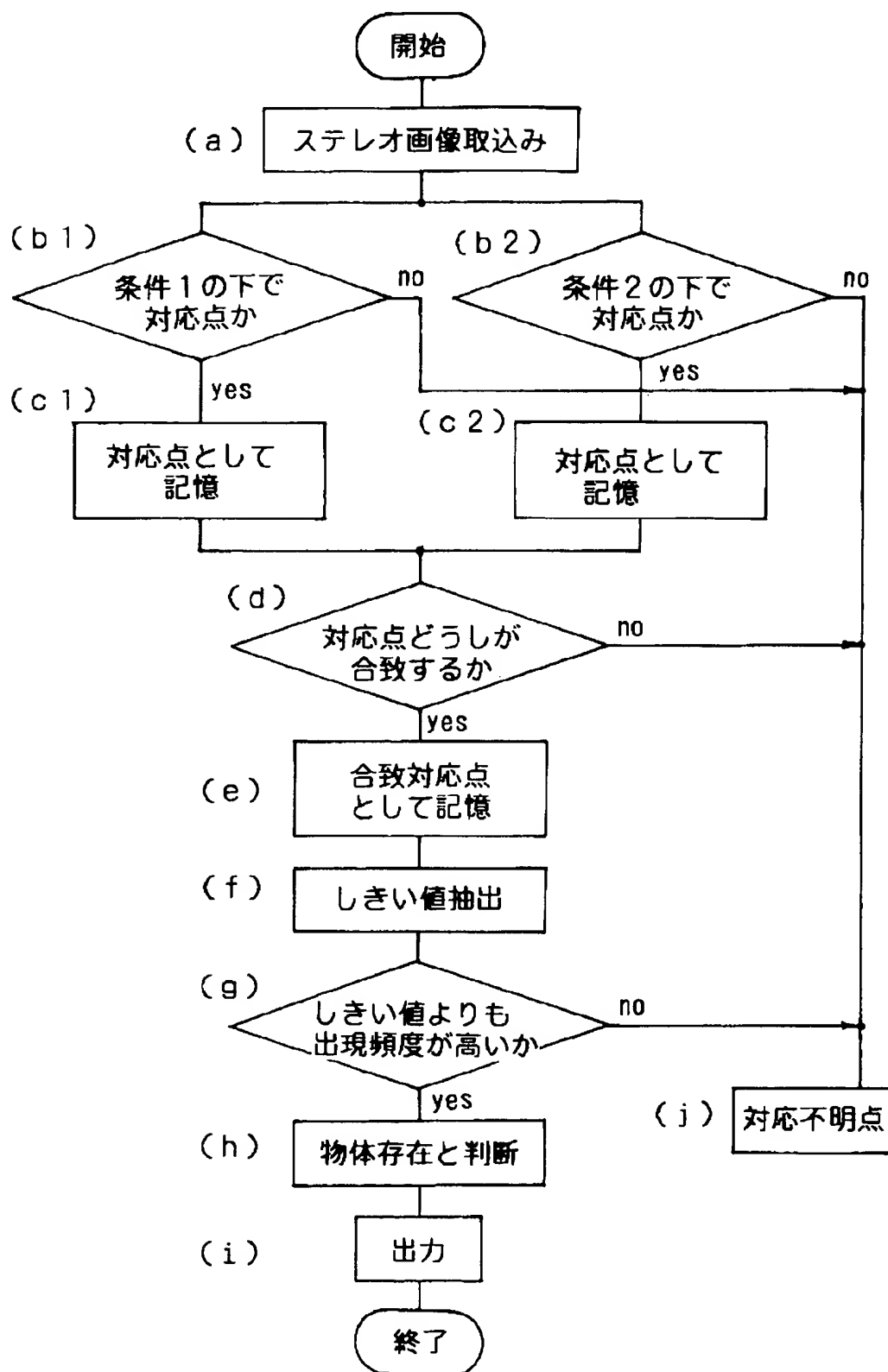Drawing selection [drawing 1 ▼]

物体存否判断装置の機能ブロック図

[Translation done.]

Drawing selection | drawing 2 | ▽ |

開始

（a） ステレオ画像取込み

（b1） 条件1の下で 対応点か — no

（b2） 条件2の下で 対応点か — no

（c1） yes 対応点として 記憶

（c2） 対応点として 記憶 yes

（d） 対応点どうしが 合致するか — no

yes

（e） 合致対応点 として記憶

（f） しきい値抽出

（g） しきい値よりも 出現頻度が高いか — no

yes

（j） 対応不明点

（h） 物体存在と判断

（i） 出力

終了

物体存否判断方法の流れ図

Drawing selection drawing 3

(A) 条件1の下で抽出された
左位相差画像

(B) 条件1の下で抽出された
右位相差画像

(C) 条件2の下で抽出された
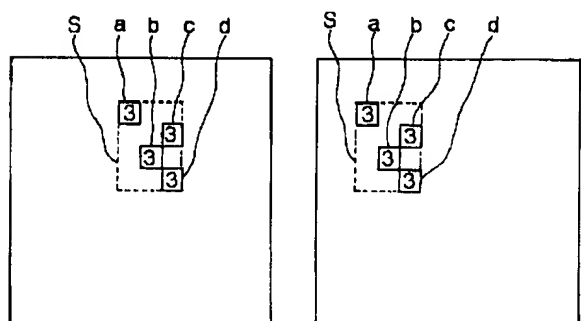左位相差画像

(D) 条件2の下で抽出された
右位相差画像

位相差画像（1）

[Translation done.]

Drawing selection drawing 4 ▽

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              ┌─────────┐
              (  開始  )
              └─────────┘
                   │
  （a）    ┌──────────────────┐
          │ ステレオ画像取込み │
          └──────────────────┘
                   │
        ┌──────────┴──────────┐
（b1）  ◇                    ◇  （b2）
     条件1の下で   no      条件2の下で   no
      対応点か              対応点か
        │yes                  │yes
（c1）              （c2）
 ┌────────────┐      ┌────────────┐
 │ 対応点として │      │ 対応点として │
 │    記憶     │      │    記憶     │
 └────────────┘      └────────────┘
        └──────────┬──────────┘
（d）              ◇
              対応点どうしが   no
               合致するか
                   │yes
（e）  ┌──────────────┐
       │  合致対応点    │
       │ として記憶     │
       └──────────────┘
                   │
（f）  ┌──────────────┐
       │  しきい値抽出  │
       └──────────────┘
                   │
（g）              ◇
              しきい値よりも   no
             出現頻度が高いか
                   │yes
（h）  ┌──────────────┐        （j） ┌──────────┐
       │ 物体存在と判断 │              │ 対応不明点 │
       └──────────────┘              └──────────┘
                   │
（i）  ┌──────────────┐
       │     出力      │
       └──────────────┘
                   │
              ┌─────────┐
              (  終了  )
              └─────────┘
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物体存否判断方法の流れ図

Drawing selection | drawing 5
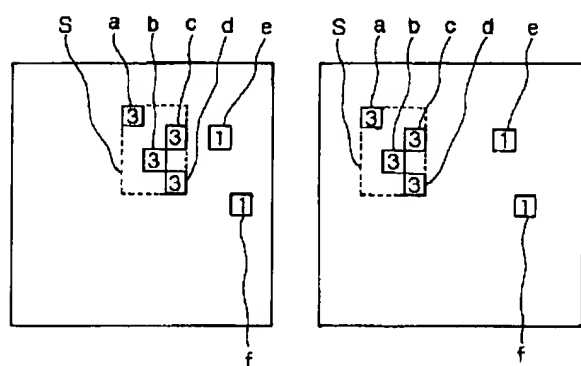
(A) 左合致位相差画像　　(B) 右合致位相差画像

(C) 左出力位相差画像　　(D) 右出力位相差画像

位相差画像（２）

[Translation done.]

Drawing selection | drawing 6 | ▽ |

出現
個数

5000

4000

3084 ------------------- Ⅱ

1000

500

0

100　50　120　60

位相差
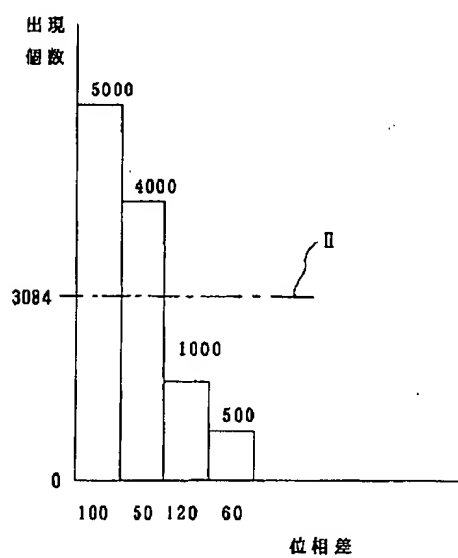
合致対応点の位相差の分布

[Translation done.]